Test and Evaluation of Cargo Explosive Detection Equipment

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Test Objectives

- Assess and provide users with technical data and information on the performance of explosives detection equipment
- Monitor new and emerging EDE technology
- Establish a basis for testing cargo inspection system requirements and qualifications

Background

- DOD Directive Issued; 5.12 Physical Security Equipment
  - 5.12.1 The Secretary of Navy to perform the management, operation and support functions, including the responsibility for programming, budgeting, funding, and publication of standards and military specification and design and performance criteria for all research and engineering of shipboard and waterside physical security systems, and anti-compromise emergency destruct (ACED) systems, explosive detection systems and robotic systems as they apply to this paragraph.

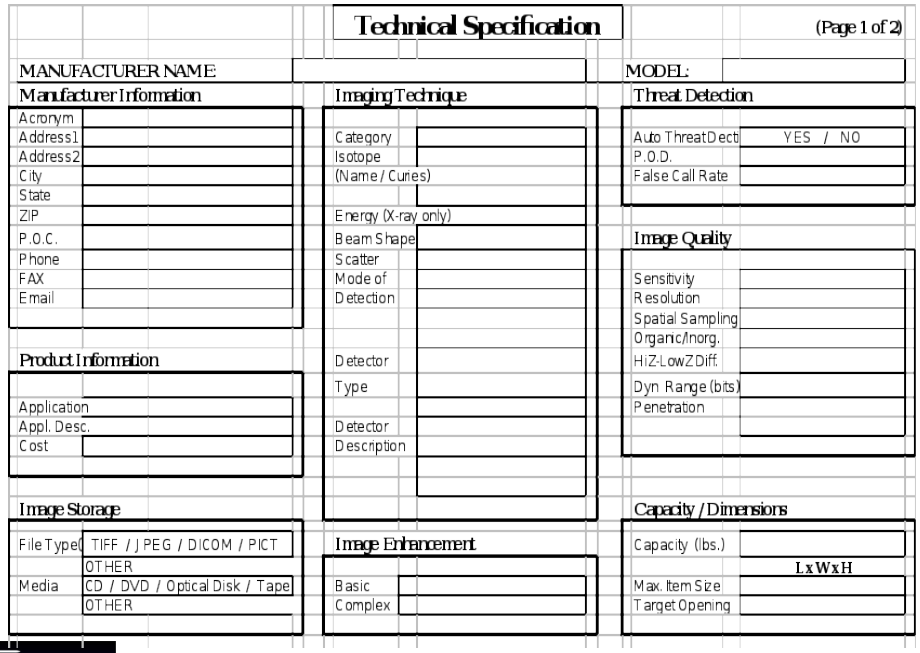
- User requirements were initially established via:
  - EDE workshops
  - Previously defined requirements by US Customs, US Air Force, FAA, TSWG and US Postal Service

Cargo EDE User Requirements

- Non-Intrusive cargo screening
- Diverse environmental operating conditions
- Power supply compatibility
- Operator training
- Probability of detection
- Useful penetration
- Contrast and spatial resolution
- Discrimination between explosives and background
- Screening rates
- Initial set-up (time) for operation
- Safety considerations
- Data records and retention

COTS Cargo EDE Review

- Identified eight manufacturers of EDE
- Obtained published technical specifications



Technical Specification (Page 1 of 2)

MANUFACTURER NAME: | MODEL:

Manufacturer Information

Acronym	
Address1	
Address2	
City	
State	
ZIP	
P.O.C.	
Phone	
FAX	
Email	

Product Information

Application	
Appl. Desc.	
Cost	

Image Storage

File Type	TIFF / JPEG / DICOM / PICT
	OTHER
Media	CD / DVD / Optical Disk / Tape
	OTHER

Imaging Technique

Category	
Isotope	
(Name / Curies)	
Energy (X-ray only)	
Beam Shape	
Scatter	
Mode of	
Detection	
Detector	
Type	
Detector	
Description	

Image Enhancement

Basic	
Complex	

Threat Detection

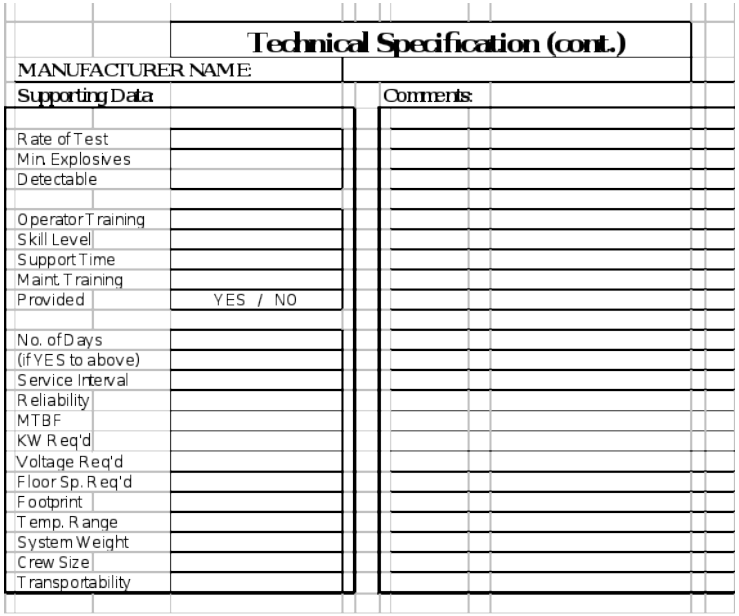
Auto Threat Dect	YES / NO
P.O.D.	
False Call Rate	

Image Quality

Sensitivity	
Resolution	
Spatial Sampling	
Organic/Inorg.	
HiZ-LowZ Diff.	
Dyn. Range (bits)	
Penetration	

Capacity / Dimensions

Capacity (lbs.)	
	L x W x H
Max. Item Size	
Target Opening	



Technical Specification (cont.)

MANUFACTURER NAME:

Supporting Data		Comments:
Rate of Test		
Min. Explosives Detectable		
Operator Training		
Skill Level		
Support Time		
Maint. Training Provided	YES / NO	
No. of Days (if YES to above)		
Service Interval		
Reliability		
MTBF		
KW Req'd		
Voltage Req'd		
Floor Sp. Req'd		
Footprint		
Temp. Range		
System Weight		
Crew Size		
Transportability		

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Established Cargo Container Test Plan

- LD-3 air cargo container selected
  - Wide use by airlines
  - Suitable for broad range of tests
- Establish IED configurations
- Design test bed arrangement and loading matrix
- Select test sites
- Conduct limited test and evaluation

Design and
n of Test
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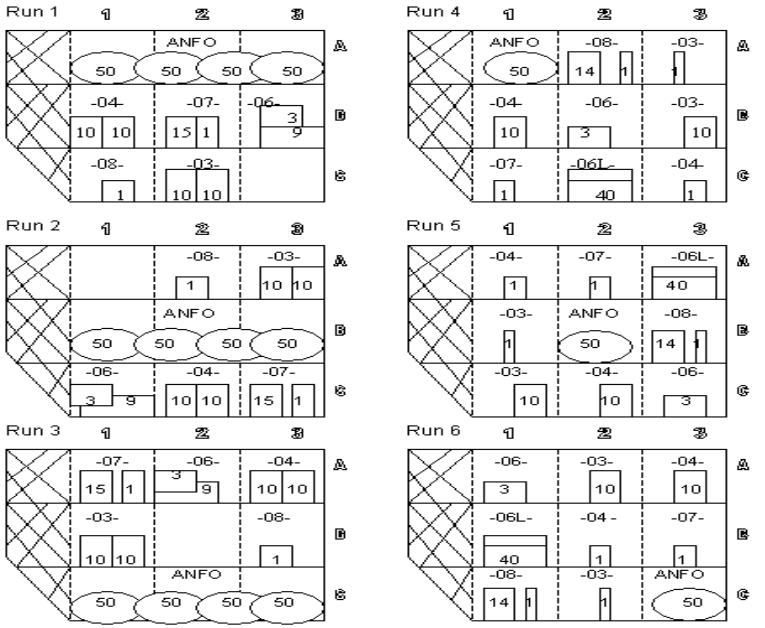

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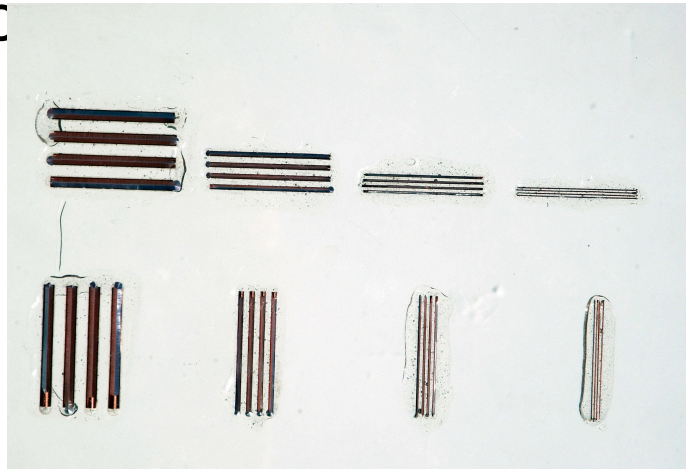
Reference Devices

- Resolution and sensitivity measured with copper wire resolution gage
- Aluminum and steel step blocks used to check penetration and contrast sensitivity
- All tests conducted outside container to eliminate masking by cargo



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Test and Evaluation Procedures

- Tests conducted in accordance with plan
- Six runs repeated at each site
- Evaluation of image by operator
- Data reviewed and documented by Indian Head monitor
- Images digitally recorded

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Evaluation of Data

- Tests scored on ability to detect:
  - Explosives
  - Igniters and wiring
  - Batteries
- Responsiveness to user requirements
- Ratings scored using weighted performance criteria

Performance Results

		Location 1		Location 2	
WT	Performance Parameters	Raw Score	Weighted Score	Raw Score	Weighted Score
95	Useful Penetration	27	2565	9	855
90	Spatial Resolution	9	810	3	270
90	System Sensitivity	9	810	3	270
100	Discriminate explosives from background	27	2700	9	90
70	Screening Rate	9	630	9	630
80	Safety requirements	9	720	9	720
40	Environmental compatibility	27	1080	27	1080
50	Image and data retention	27	1350	27	1350
615	SCORE	144	10665	96	5265
	Normalized Score		17.34		8.56

Notes: Raw Scores = Unsatisfactory-0, Poor-1, Average-3, Above Average-9, Excellent-27
Background is defined as the images resulting from cargo and the container.

Identification Results

		1	2
	Actual		
IED FINDS			
level A	18	16	14
level B	18	15	13
level C	18	8	9
Total	54	39	36
BATTERY FINDS			
level A	6	6	6
level B	9	7	6
level C	8	5	1
Total	23	18	13
DETONATOR FINDS			
level A	5	0	3
level B	6	0	1
level C	3	0	0
Total	14	0	4
1 POUND QUANTITIES			
level A	4	3	1
level B	4	3	0
level C	4	1	0
Total	12	7	1
10-20 POUND QUANTITIES			
level A	7	7	7
level B	7	6	7
level C	7	5	4
Total	21	18	18

Conclusions

- The probability of detecting small weights of explosives is low
- Detection is strongly related to explosive shape and volume
- Cargo uniformity directly enhances detection
- Explosive equipment cannot be directly compared in terms of application and capability

Recommendations

- Establish a direct testing connection between the users' requirements and the manufacturers' products
- National Standards for grading EDE:
  - Size/geometry of items to be examined
  - Cargo density range/penetration
  - Number of views for full coverage
- Standard practice for performance verification
- Establish uniform training and certification of operators